Bulletin of Environment, Pharmacology and Life Sciences
Bull. Env. Pharmacol. Life Sci., Vol 6 Special issue [2] 2017: 07-09

Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD
Global Impact Factor 0.533
Universal Impact Factor 0.9804
NAAS Rating 4.95

FULL LENGTH ARTICLE **OPEN ACCESS**

Fertilizer Rates Verification and Prescription Based on Soil Test Crop Response for Soybean Grown In Mid Hills of Meghalaya

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ABSTRACT
An experiment on soil test crop response (STCR) correlation studies was conducted on soybean in mid hills of Meghalaya during Kharif season of 2005. Multiple regressions equations have been calibrated for predicting soybean yield through soil and fertilizer nutrients. Using the basic fertilizer response data, crop nutrient requirement per quintal of grain production, efficiency of soil available nutrients and efficiency of fertilizer nutrients were worked out. The nutrient requirement (kg q^{-1}) of N, P_2O_5 and K_2O were found to be 6.97, 1.42 and 1.04, respectively for producing one quintal of soybean yield in Meghalaya.. The fertilizer adjustment equations and a ready reckoner of optimum fertilizer doses at varying soil test values for attaining yield target of 40 and 50 qha^{-1} of soybean yield have been calibrated based on the targeted yield concept. Using these fertilizer equations, four field experiments with soybean were conducted during kharif 2006 at different locations in farmers' fields. The experiments indicated that it is possible to target the soybean yield up to 45 q ha^{-1}. The targeted yield equations and the fertilizer ready reckoner developed for soybean grown in Meghalaya are useful for large scale recommendation by the soil testing laboratories of Meghalaya. along with fertilizer adjustment equations.
***Key words**: Soybean, fertilizer equation, fertilizer recommendations, targeted yield*

Received 10.07.2017 Revised 19.08.2017 Accepted 21.08.2017

INTRODUCTION

Soybean is the second major cereal crop grown in the NEH Region. Soybean plant thrives well in a soil having neutral soil reaction and sandy to silty clay loam in texture. Most of the soils of NEH Region are acidic and light in texture. The productivity of soybean crop and per capita availability of soybean in North Eastern Region of India is quite low. Average yield of soybean in Meghalaya is around 1 t ha^{-1}. The production potential of the crop in Meghalaya is much higher than the average production of the crop. Out of several reasons cited for its low productivity, the imbalanced nutrition of of N, P and K is the most limiting one. Generally farmers of Meghalaya avoid applying fertilizers and this is the reason very low fertilizer use efficiency has been accounted. Soybean is a heavy feeder of nutrients and response of added fertilizer is very common. The balanced nutrition of NPK assumes greater significance in soybean crop to increase use efficiency of NPK and to enhance productivity. Fertilizer recommendations, at present, are usually given for different crops by taking consideration only the available nutrient status of the soil prior to raising a crop, the soil being categorized as low, medium and high fertility classes. These are generalized recommendations and do not take into account the large-scale variations from field to field. An attempt has been made in this paper to summarize the basic information obtained from prescription-based fertilizer recommendation for soybean crop.

MATERIALS AND METHODS

A field experiment based on STCR methodology on soybean with the variety 'RCM 1-1' was conducted at ICAR Research Complex for NEH Region, Umiam in Riboi district from 2004-05 to 2005-06. The soil at Umiam farm was Ultic Hapludalf with pH 4.75, organic carbon 18.3 g kg^{-1}, exchangeable Ca+Mg 1.76 cmol(p^+)kg^{-1}, available N (alkaline $KMnO_4$ oxidizable), P (Bray-2) and K (1*N* NH_4OAc extractable) 477, 11.5 and 167 kg ha^{-1}, respectively. The field layout for crop essentially comprised four equal strips in which a gradient in soil fertility was artificially created by applying graded doses of N, P and K fertilizer so

as get a wide range in soil fertility ($N_0P_0K_0$, $N_{½}P_{½}K_{½}$, $N_1P_1K_1$ and $N_2P_2K_2$; $N_1P_1K_1$: 80, 60, 40kg/ha). An exhaustive crop was later on raised on these four strips to stabilize the soil system. For the test crop of soybean, the soybean itself was the exhaustive crop. After the harvest of exhaustive crop, the experiment with soybean as test crop was conducted in the subsequent season by dividing each of the four fertility strips into 30 plots which received 27 selected treatments out of the combination of three levels of N, three levels of P_2O_5 and three levels of K_2O. The remaining three sub-plots in each fertility strip were kept untreated as control and experiment was conducted in a RBD. design (Ramamoorthy & Velayutham 1971). The plant samples viz. grain and straw samples collected at harvest were analysed for N, P and K and the plant uptake of nutrients was calibrated by using grain and straw yield data. Using the grain yield and nutrient uptake data, soil test values and applied fertilizer doses of treated and control plots, the basic data *viz*. nutrient requirement (kg q^{-1}), soil and fertilizer efficiencies (%) for making fertilizer recommendation were estimated by conventional procedure as discussed by Ramamoorthy *et al*. (1967) and followed in the STCR Project.

The soil efficiency was estimated from only unfertilized plots, while the fertilizer efficiency was estimated from fertilized plots. The nutrient requirement was estimated from both the fertilized and unfertilized plots. The computational procedure of basic data is well discussed in Ramamoorthy *et al*. (1967) and Reddy *et al*. (1994). The estimates of basic data were used for developing fertilizer adjustment equations for deriving optimum fertilizer test- based fertilizer recommendations had been prescribed in the from of a ready reckoner for different yield targets.

RESULT AND DISCUSSION

The basic data *viz*., the nutrient requirement (kg q^{-1}) for producing one quintal of soybean yield, soil and fertilizer efficiencies or the percent contribution from soil and fertilizer nitrogen, phosphorus and potassium have been calculated from each plot based on the data and have been presented in table 1. The estimates of nutrient requirement (kg q^{-1}) value of nitrogen, phosphorus and potassium based on yield maximum method were 6.97, 1.42 and1.04, respectively. The percent nutrient contributions from soil and fertilizer nutrients in Ultic Hapludalf were found to be 22.63, 11.30 and 4.87; 38.50, 26.24 and 23.00 for nitrogen, phosphorus and potassium, respectively under yield maximum method. This result indicated that nutrient contributions from the fertilizer source are more than from the soil source which is in close conformity with the results reported by Reddy et al. (1994).

Using fertilizer adjustment equations derived under yield maximum method, ready reckoner showing optimum N, P and K fertilizer doses at varying soil test values for attaining yield targets of 40 and 50 q ha^{-1} of soybean yield is given in table 3. The result clearly indicates that the fertilizer dose required for attaining a specific yield target of soybean yield is decreasing with increasing soil test values.

Field verification trials were conducted in two villages of Riboi district (table 4) for attaining a yield target of 40 and 50 q ha^{-1} during kharif 2006. The doses tested are based on the fertilizer adjustment equations calibrated for soybean crop, along with the farmers' practice (FP) and state level recommended doses (SLD). The yield target of 40 q ha^{-1} could be achieved in both location tested, but 50 q ha^{-1} yield target could not be achieved.

Table1. Basic data for targeted yield equation for Soybean

Crop	Particular	Nitrogen (N)	Phosphorus (P_2O_5)	Potassium (K_2O)
Soybean	Crop nutrient requirement (kg q^{-1} grain)	6.97	1.42	1.04
	Nutrient contribution from soil (%)	22.63	11.3	4.87
	Nutrient contribution from fertilizer (%)	38.50	26.24	23.00

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Table2.Fertilizer adjustment equations for soybean

Crop	Fertilizer equation
Soybean	FN = 1.81 x T- 0.06 x SN
	FP_2O_5 = 5.42 x T- 4.33 x SP
	FK_2O = 4.51 x T- 0.21x SK

Note: FN, FP_2O_5 and FK_2O are fertilizer N, fertilizer P_2O_5 and fertilizer K_2O, respectively, and SN, SP and SK are the soil test values for N, P and K in their elemental form and T is the predetermined crop yield target (qha^{-1}).

Table 3. Ready recknoer of different doses at varying soil test values for specific yield targets of soybean in Ultic Hapludalf.

Target yield (q/ha)	Fertilizer dose in Low NPK soil			Fertilizer dose in Medium NPK soil			Fertilizer dose in High NPK soil		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
5	3.05	None	1.55	None	None	None	None	None	None
10	12.1	10.9	24.1	3.1	None	3.1	None	None	None
15	21.15	38	46.65	12.15	None	25.65	None	None	4.65
20	30.2	65.1	69.2	21.2	21.8	48.2	6.2	0.15	27.2
25	39.25	92.2	91.75	30.25	48.9	70.75	15.25	27.25	49.75

Table 4. Field verification trials of fertilizer adjustment equations of soybean in Ultic Hapludalf of Riboi district of Meghalaya.

Farmer /Village	Soil test values (kg ha^{-1})			Treatment	Fertilizer doses (kg ha^{-1})			Yield (q ha^{-1})
	N	P	K		N	P_2O_5	K_2O	
O. Khapran/ Phyllum block IV	464.13	12.31	284.93	FP	Nil	Nil	Nil	20.12
				SRD	80	60	40	23.42
				40q ha^{-1}	28.55	58.25	16.10	47.28
				50q ha^{-1}	48.45	73.15	24.40	48.75
O. Khapran/ Phyllum block II	423.03	16.75	201.16	FP	Nil	Nil	Nil	19.89
				SRD	80	60	40	24.32
				40q ha^{-1}	33.07	57.76	21.13	45.62
				50q ha^{-1}	52.97	72.66	29.43	47.55

*FP = Farmer's practice

**SRD = State recommended dose (80, 60 & 40 kg ha^{-1} N, P_2O_5 & K_2O, respectively

CONCLUSION

Hence it may be concluded from the experiment and subsequent field trials that the fertilizer adjustment equations and the ready reckoner of optimum fertilizer doses at varying soil test values developed for soybean grown in mid hills of Meghalaya may be recommended for large scale use by the soil testing laboratories of Meghalaya for the Kharif season.

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CITATION OF THIS ARTICLE

L. Somendro Singh, Brajendra And Patiram . Fertilizer Rates Verification and Prescription Based on Soil Test Crop Response for Soybean Grown In Mid Hills of Meghalaya**.** Bull. Env. Pharmacol. Life Sci., Vol 6 Special issue 2, 2017: 07-09